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IDAHO DAIRY NUTRIENT MANAGEMENT

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Summary: The Idaho State Department of Agriculture has been regulating the dairy waste program for four years. The first phase of the program, waste containment, is nearly complete so the program is now shifting to nutrient management. The Idaho State Department of Agriculture has worked closely with the Idaho Natural Resources Conservation Service to revise their Nutrient Management Standard, Code 590. Recent state regulations require all dairies in the state to develop and implement a nutrient management plan within the next several years. The nutrient management plans for dairies will essentially be phosphorus based for manure application, with regulatory soil phosphorus testing required.

Keywords: Nutrient Management, Dairy Waste, Manure Application, Phosphorus

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Idaho Dairy Nutrient Management

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Summary

The land application of livestock waste is an important element of Idaho's surface and groundwater quality concerns. The rapidly expanding dairy industry (ranked 6th nationally in milk production) has recently been targeted as a major contributor to groundwater and surface water degradation. The Idaho State Department of Agriculture (ISDA) is responsible for regulating farm sanitation and waste management on dairies in the state. ISDA began the waste land application rule making process in 1997 with final legislative approval coming in early 1999.

ISDA has worked closely with the Idaho Natural Resources Conservation Service (NRCS), and other state and federal agencies, to revise and update the NRCS Nutrient Management Standard, Code 590. The national NRCS Nutrient Management Standard was also being revised simultaneously. The Standard was tested on ten Idaho dairies to determine its effectiveness and practicality prior to adoption.

The Standard will be used on all dairy facilities in Idaho as part of the dairy waste regulatory program administered by the ISDA. In addition to being required to prepare and operate under the plan, dairies will also be subject to periodic regulatory soil sampling to insure compliance with their nutrient management plan. Facilities found out of compliance with their nutrient management plan will be subject to regulatory action, including permit revocation.

Background

The Idaho dairy industry has grown rapidly in the last nine years with nearly an 85% increase in milk production during this time period. The dairy numbers steadily decrease each year, but the shift to larger dairies keeps the cow numbers increasing every year. Many of the larger new dairies in Idaho are coming from other states such as California and Washington. Although this growth is expected to slow, it should continue.

In late 1995, the Idaho Dairy Pollution Prevention Memorandum of Understanding (MOU) was signed which transferred the dairy waste program from Idaho Division of Environmental Quality (DEQ) to ISDA. This MOU was initiated by the Idaho Dairyman's Association and was also signed by the Environmental Protection Agency (EPA), DEQ, and ISDA. The regulatory enforcement prior to the MOU consisted of approximately 50 inspections annually by DEQ and EPA with fines being the major regulatory tool. ISDA currently inspects dairies on the average of three times a year with compliance assistance being the primary regulatory tool. ISDA has the authority to revoke a facility's permit to ship milk if there is a discharge or a repeat non-compliance issue, which has been a very effective means of insuring compliance.

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The initial goal of ISDA under the MOU was to control discharges from containment systems to surface and groundwater. That phase of the program took approximately two years to complete. The next phase of the program is the land application of dairy manure and wastewater. The distribution of dairies in Idaho is not consistent with the agricultural land base (Figure 1). The Magic Valley of Idaho has the largest percentage of dairies, yet does not have a large portion of the land base. Much of the alfalfa hay fed on the Magic Valley dairies comes from an area 150 miles northeast. The production agriculture ground in southern Idaho is located on the Snake River Plain where the soil is shallow to fractured basalt and often very permeable. The nutrient distribution problem and geology forced ISDA to work with several state and federal agencies last year to modify the existing regulations and draft new rules specifically dealing with the land application of dairy waste. These rules were approved as temporary rules by the 1998 Idaho Legislature and were adopted as final rules during the 1999 Legislative session.

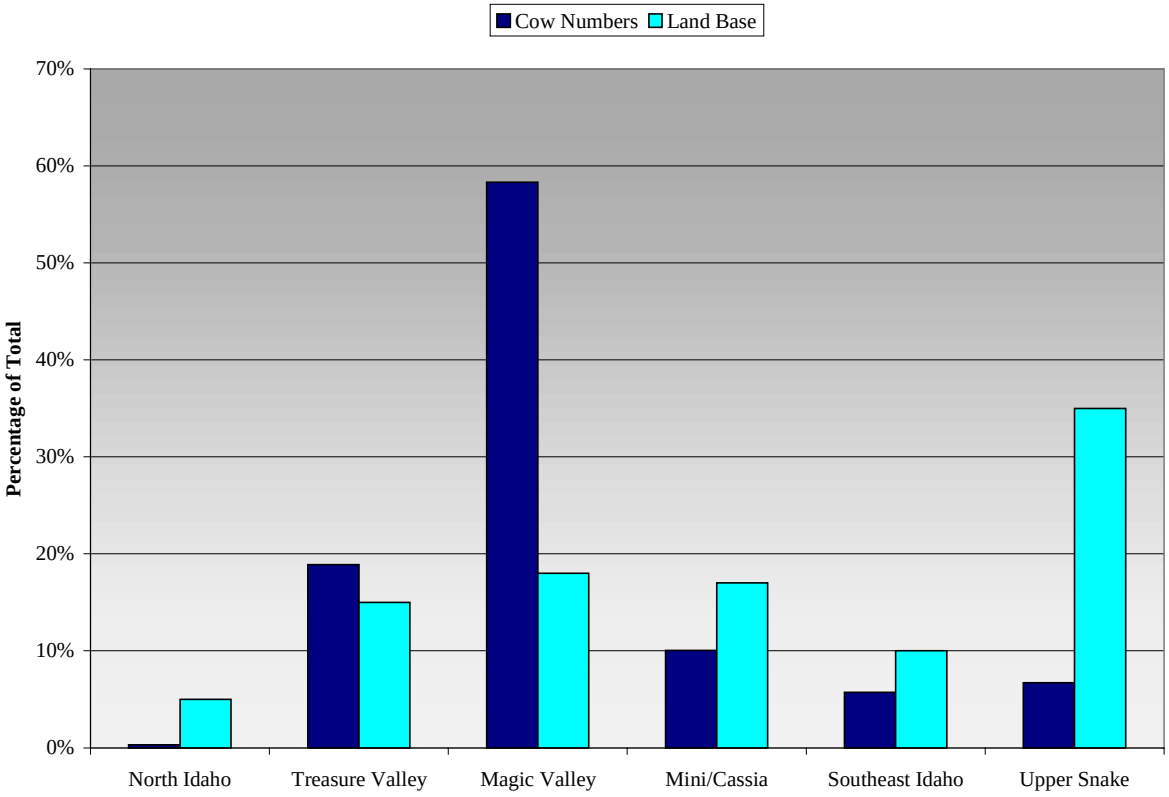

Figure 1. Cow Numbers vs. Agricultural Land Base

ISDA has worked extensively with NRCS and the University of Idaho (U of I) during the containment portion of the waste program and continues this relationship through land application. NRCS began the revision of their Nutrient Management Standard with input from ISDA and U of I, in addition to producer groups and other state and federal agencies. The Standard should be adopted by September 1999.

ISDA will use the Idaho NRCS Nutrient Management Standard as a guideline for the preparation of Nutrient Management Plans (NMP's) for all dairies in Idaho. This will require the preparation of approximately 1000 NMP's within the next two years. These plans will be prepared by certified planners that have completed the certification process.

Nutrient Management Standard Overview

Although the Idaho NRCS Nutrient Management Standard revision was prompted by the dairy industry situation, the Standard does apply to all irrigated and dry cropland. NRCS will use this Standard on all farms, whether the nutrient source is livestock waste or commercial fertilizer. The primary objectives of the Standard are to prevent deep-percolation of nitrogen, limit phosphorus runoff from cropland, and limit vertical movement of phosphorus in the soil horizon. The shallow, permeable soils in southern Idaho make phosphorus percolation into groundwater a serious concern. Several of the shallow aquifers along the Snake River Canyon daylight to surface water.

The Standard is currently written to allow the use of table values for the nutrient content of manure for small facilities or facilities with simple waste management systems. Larger facilities with complex waste management systems, such as mechanical separators, recirculating flush systems, and settling basins, require nutrient analysis of manure or effluent before or during application of the waste. Although this method does not receive unanimous support nationally (Lorimor et al., 1997), several regulatory agencies are using it as a method for developing and regulating nutrient management plans. Dairies in Idaho typically do not use a pit manure system. The management option most widely used is an open-lot bedded pack system. There are also a small number of freestall facilities, but manure is typically stacked in a drying area. Although nitrogen is difficult to account for in these systems, the phosphorus appears fairly predictable. The Standard does require annual soil testing for nitrogen to determine availability prior to planting, which will also account for the variable mineralization rates common in Idaho.

A major element of the Nutrient Management Standard is regulatory soil testing for phosphorus levels. The primary purpose of these samples is to insure compliance with the nutrient management plan and monitor the long term environmental effects of the plan. Each field has a regulatory phosphorus soil sample taken at a depth dictated by the resource concern (Table 1) at plan development. The same field is then sampled at least every five years to determine whether the soil test phosphorus value is increasing or decreasing. This method of testing will allow ISDA to determine compliance with the nutrient management plan, including insuring the correct application rates were used.

Table 1. Soil Sampling Depth

Primary Resource Concern	**Threshold P Soil Sample Depth**
Surface Water Runoff*****	0-30cm (0 – 12”)
Ground Water, fractured Bedrock, cobbles or gravel	46-61cm (18 – 24”)

* Surface water runoff concerns exist when runoff leaves the contiguous operating unit from average storm events, rain on snow, or frozen ground or irrigation.

Manure or wastewater application rates are determined by comparing the soil test phosphorus values to the applicable threshold values listed in the Standard. These thresholds are split into two primary categories within the Standard. The first is if the land application field is gravity irrigated (furrows, corrugates, border strip) without tail water return or the field is a significant precipitation runoff concern (Table 1). If the site falls under these conditions, the soil test phosphorus threshold is 40 ppm in the 0-30cm (0-12") sample, using the sodium bicarbonate test procedure (Table 2).

The second main category of thresholds is if no significant runoff occurs from the field. In this situation there are two subcategories with different thresholds based on depth to resource concern (groundwater, fractured bedrock, extremely permeable layer). If the depth to resource concern is less than 1.5m (5'), the soil test phosphorus limit is 20 ppm in the 46-61cm (18-24") soil sample (Table 2). If the depth to resource concern is greater than 1.5m (5'), the soil test phosphorus limit is 30 ppm in the 46-61cm (18-24") soil sample.

Table 2. Phosphorus Threshold Value

Primary Resource Concern	**P Threshold Concentration**	
	$NaHCO_3$	**Bray 1**
Surface Water Runoff	40 ppm	60 ppm
Ground Water, fractured bedrock, cobbles or gravel		
< 5 feet of soil	20 ppm	25 ppm
> 5 feet of soil	30 ppm	45 ppm

Table 3. Phosphorus Application Guidelines

Soil Test P	**P Application Rate**
Surface Water < TH ppm > TH ppm*	 Recommended rates or Crop P uptake Crop P uptake
Ground Water < TH ppm > TH ppm*	 Recommended P rate or Nitrogen based Crop P uptake

***** **Note:** When soil test P concentrations are above the TH, the planner, in cooperation with the producer, will design a nutrient management plan that will reduce soil test P concentrations below the TH and minimize potential offsite transport. This may require adjustments in crop rotation, irrigation method and scheduling, form, timing or placement of P applied, and changes in P application rates less than crop P uptake.

The phosphorus soil test and its relation to the threshold determine the rate for manure or commercial phosphorus application. Soil test values below the threshold allow the application of phosphorus at the University of Idaho Fertilizer Guide recommendation. Soil test values at or above the threshold require phosphorus application rates to be held at or below crop uptake (Table 3). Because of the relatively stable nature of phosphorus in the soil, the application rate is based on the entire crop rotation. Therefore, high rates of manure or commercial phosphorus may be applied during two years of a six year rotation, as long as the total phosphorus application during the rotation doesn't exceed the crop phosphorus uptake of the entire rotation.

Irrigation water management is the most important element of the nutrient management plan. Nitrogen budgeting is also used to prevent nitrate loss to groundwater, but proper irrigation management is the single most important factor in keeping nitrogen within the active crop root zone. The nutrient management planner must perform a thorough evaluation of the producer's irrigation system and practices. Requirements are set and recommendations are made in the nutrient management plan to improve the overall farm irrigation efficiency, specifically related to deep percolation of nitrates and runoff of phosphorus.

In conjunction with the irrigation system evaluation, the hydraulic loading of liquids application is determined. This process will determine the non-application window for liquid waste. Typically this window is from the last irrigation to March of the following year, usually 150-180 days. This hydraulic loading is calculated using 10 yr. precipitation data. Idaho's relatively low annual precipitation (25cm (10")) make this liquid application prior to crop emergence an acceptable practice.

The liquid wastes from the dairies are typically spread through irrigation systems. The systems can range from furrow or corrugate irrigation with siphon tubes to center pivot irrigation systems with drags or drops. Many of these systems require a chemigation system in accordance with Idaho laws and rules related to chemigation. During the preparation of the nutrient management plan, the planner must also verify the effectiveness of the water supply protection devices or methods.

Planner Certification

Nutrient management plans must be written by certified planners in Idaho. To become a certified planner, one must attend the Nutrient Management Certification Training and develop two nutrient management plans that are approved by a certified planner. The Nutrient Management Certification Training program was developed during the summer of 1998. The course is taught through the Idaho Department of Agriculture in conjunction with the Natural Resources Conservation Service and the University of Idaho. It is a four day course covering nutrient cycling through the environment and cropland, introduction to soil survey and soil sampling techniques, irrigation management, manure management, rules and regulations governing land application of dairy waste, chemigation and hydraulic water balance to determine timing of effluent application.

During the course attendees are taken through two example nutrient management plans, one with animal waste and one without. A mock test is given the final day of the course to assess the individual's ability to write nutrient management plans. Most attendees choose to work in groups. This setting offers the opportunity for discussion among the class. Open discussion has been very valuable in the learning process to interconnect specific subjects into nutrient management.

After attending Nutrient Management Certification Training an individual is qualified to begin writing nutrient management plans. A certified planner must sign off the first two plans that are written after attending the training. In the past it has been beneficial for newly trained individuals to complete their first plan with a certified planner.

Nutrient management plans developed for dairies must be approved by the Department planners. The report is evaluated for compliance with the Nutrient Management Standard and Department Regulations. When approved, the appropriate information is entered into a database for tracking environmental impacts.

Ten Nutrient Management Certification Training courses have been taught across the state since November 1998. Over 133 individuals have attended the course. Fifty-nine percent of the individuals have come from government agencies (Figure 2) including, Idaho Department of Agriculture, Natural Resources Conservation Service, and the Idaho Division of Environmental Quality. Consultants make up 39% of trained individuals. Consultant's range from employees of fertilizer companies to civil and environmental consultants. The remaining population consists of individual farmers and interest groups.

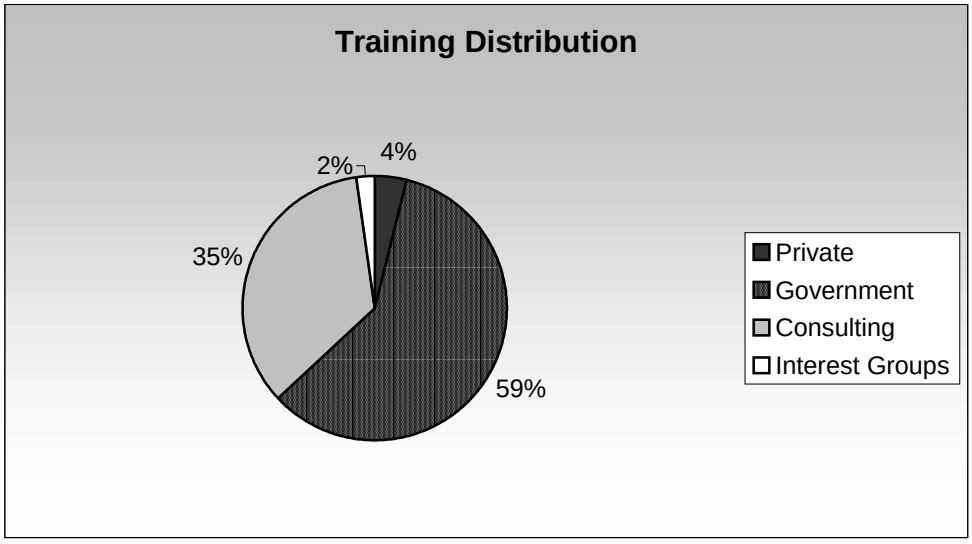

Figure 2. Training Distribution

Although attendance numbers for the Nutrient Management Training Certification are somewhat impressive, there are only six Certified Nutrient Management Planners in the state. Two of these individuals are private consultants, the remainder are from government agencies. We feel that timing has played a significant role in these numbers. The majority of trained individuals were educated during the early spring. Being busy with other agricultural interests, we feel that certification will increase during the winter months, when other agricultural business slows down.

Regulatory Process

The MOU transferring the dairy waste program to ISDA, also outlined the penalty provisions for the program. Every dairy is issued a permit from ISDA to sell milk, however, the permit may be revoked for sanitation or waste violations. A discharge from the facility is usually grounds for revocation of the permit for one day. Therefore, the penalty is essentially one day's receipts from the sale of milk. This permit revocation may be reduced to a portion of a day's production or increased to several days for repeat offenders or lengthy discharges.

The nutrient management program will require a slightly different regulatory approach. Producers must limit liquid waste applications to the application window developed for their facility. Any application outside of this window will be considered a serious non-compliance issue requiring enlargement of the existing containment facilities. Runoff of liquid waste from land application fields will be considered a discharge. Solid manure may be applied at any time during the year, however, runoff will not be allowed to leave the field until the manure has been incorporated. Most dairies in Idaho land apply solid manure during the spring or fall, but a low percentage of small producers land apply throughout the year. This practice will be allowed if the field is properly protected from runoff due to precipitation.

The regulatory soil testing will also be an integral portion of the regulatory program. The initial phosphorus samples are taken at plan development. Additional samples will be taken at intervals not to exceed 3 years. These samples will be compared to the previous samples to determine the overall trend of soil phosphorus. If the trend is increasing, the plan will be reevaluated to determine the discrepancy. The soil testing requirements will be increased to insure that manure applications are being made in accordance with the plan. Manure applications in excess of plan recommendations will be handled as serious non-compliance, which can lead to permit revocation.

Conclusions

Limited data is available at this time regarding the beneficial environmental effects of this program. However, much of this information will be obtained in the next several years. The first indication of positive effects of nutrient management may become apparent in Idaho's TMDL process. Several agencies are currently working on stream segment assessment and conservation practice implementation. A few of the small affected stream segments do have dairies located within them. Continued monitoring of these stream segments will likely show improvements due to dairy nutrient management.

There is limited nitrate contamination in southern Idaho's groundwater. The dairy nutrient management program is certainly a positive step towards the solution of this problem, but realistically the majority of the nutrients applied in this area are from commercial fertilizer sources. Therefore, it will be difficult to determine the effectiveness of the program from continued statewide and regional groundwater monitoring. Site specific groundwater monitoring must be implemented on several facilities to determine the effectiveness of the dairy nutrient management program. In the future, all agricultural fields within these areas of nitrate concern may need to implement irrigation scheduling programs or nutrient management plans to reduce and eliminate the groundwater contamination.

Although the Standard requires animal waste to be spread at phosphorus rates, this has very little effect on the smaller self-sustained facilities. Dairies raising the majority of their own feed

have few problems applying waste at the phosphorus rate. Larger dairies that are typically importing alfalfa hay and corn silage are greatly affected by the phosphorus application rate. The nutrient management program becomes more difficult for the large dairies that must export waste off the facility. Although over 60% of the dairies in Idaho are under 200 cows, they account for less than 20% of the milking cow in the state (Figure 3).

The waste management system becomes a very important part of the nutrient management plan. The liquid waste typically is spread on ground owned by the dairy operator, as getting the wastewater off-site can be quite expensive. Therefore, the amount of nutrients in the liquid waste system becomes very important. Small facilities usually only have parlor waste going to the liquid system, while many large freestall facilities are flushing alleys which takes all manure to the liquid system. On these flush facilities, the separation system becomes very important to reduce the nutrients available in the liquid waste stream.

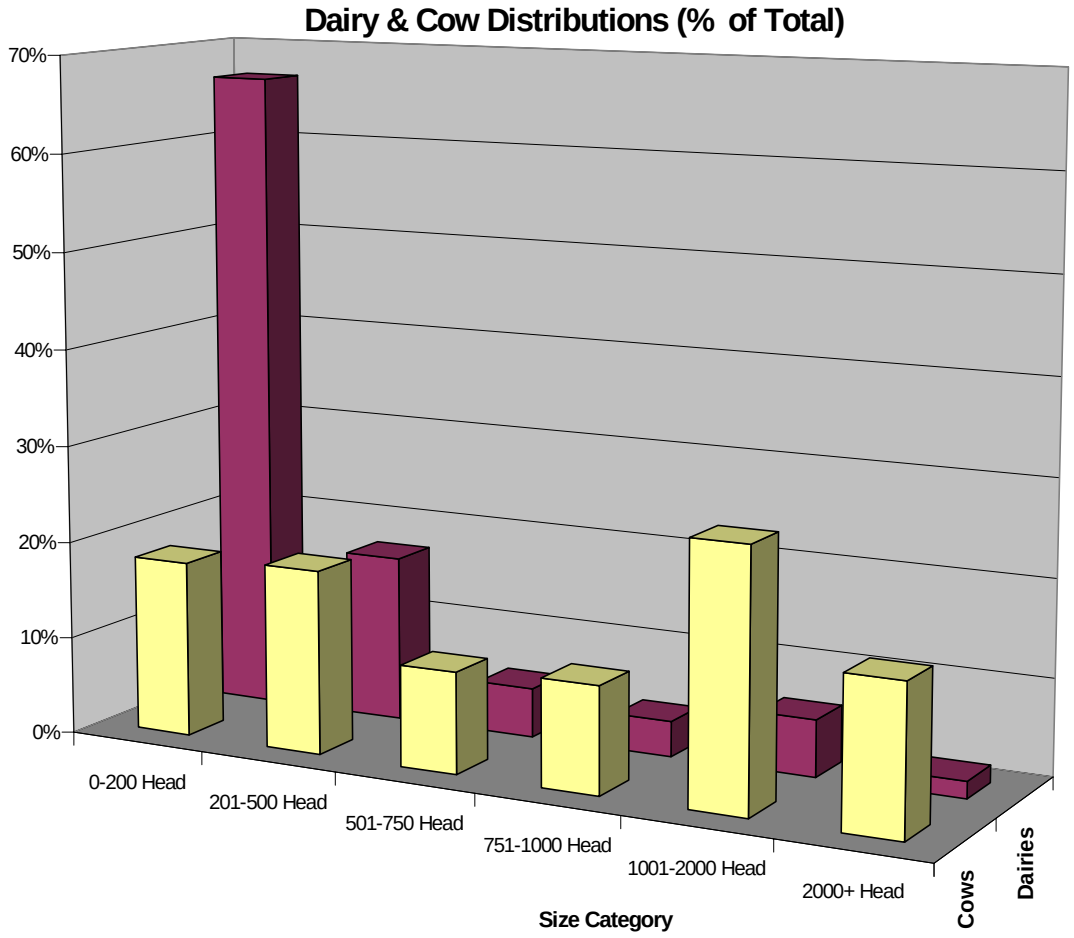

Figure 3. Dairy and Cow Distribution by % of Total

Producers throughout Idaho have begun exploring different waste treatment systems, from composting to manure digesters. Although these systems have excellent benefits, including stabilizing nutrients in the land application product, reducing odor, improving product quality, and reducing product variability, treatment does little if anything to reduce phosphorus levels in the waste stream. These systems can be used to move the phosphorus from the liquids to the solids stream, which may serve as a useful tool for some producers.

The economic effect of the nutrient management program on producers is difficult to predict due to the variability between producers and areas. ISDA is working with NRCS to gather this information and make projections for producers later in the program.

Producers in the less dense dairy regions typically make arrangements with local farmers who will pay, or at least split, manure shipping and application costs. These same producers will usually have their nutrient management plans prepared by state or federal agency staff. Some of these producers have actually been able to reduce commercial fertilizer application by the required annual soil sampling and proper application of manure and wastewater.

Producers in the dense dairy regions face a different situation entirely. Many of these dairies are large and located in close proximity to other large facilities. This reduces the availability of local farm ground for manure application. The increasing demand for land application acreage raises the cost to the dairy producers for waste disposal. Most of these producers are paying the entire manure hauling bill, which averages nearly $30,000 per 1000 cows. Many of the large facilities are paying consultants to prepare nutrient management plans, costing $2000-$4000 per facility. In the denser areas, waste was typically applied to meet nitrogen needs, however, under phosphorus application rates the facilities will have to purchase commercial nitrogen.

Additional economic effects on producers related to the nutrient management program include containment facility upgrades, irrigation system modifications, and changes to nutrient management practices. These costs are difficult to quantify due to the variety of upgrades which may be required. The various upgrade requirements are shown in Figure 4, based on the limited data available at this time.

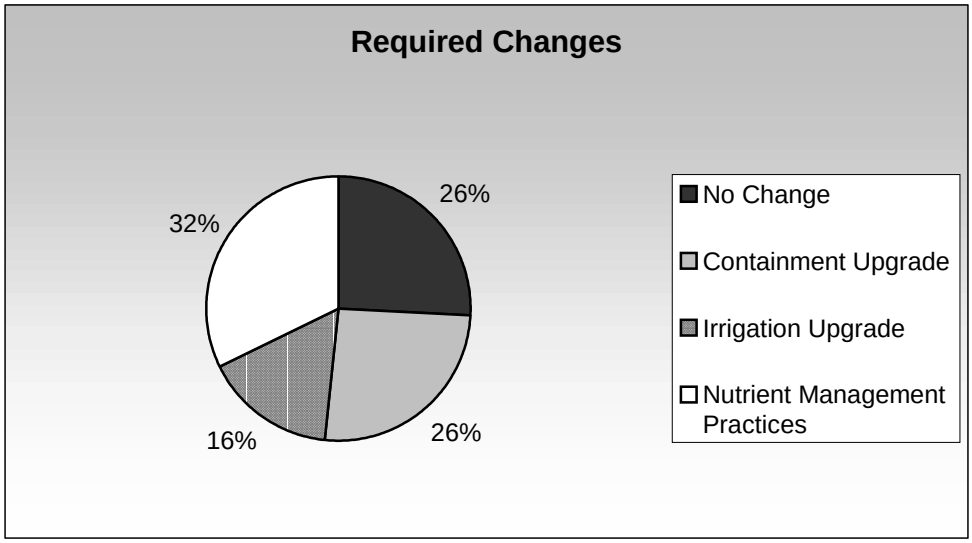

Figure 4. Upgrade Requirements

ISDA has currently worked with a small percentage of the dairies in the state developing nutrient management plans. The data available is quite limited, representing less than 5% of the dairies in the state. The ratio of groundwater versus surface water concerns are shown in Figure 5. This graph also identifies the ratio of facilities which have soil tests over the phosphorus threshold. The ratio of groundwater versus surface water concerns approximately matches Idaho's ratio of flood versus sprinkler irrigation.

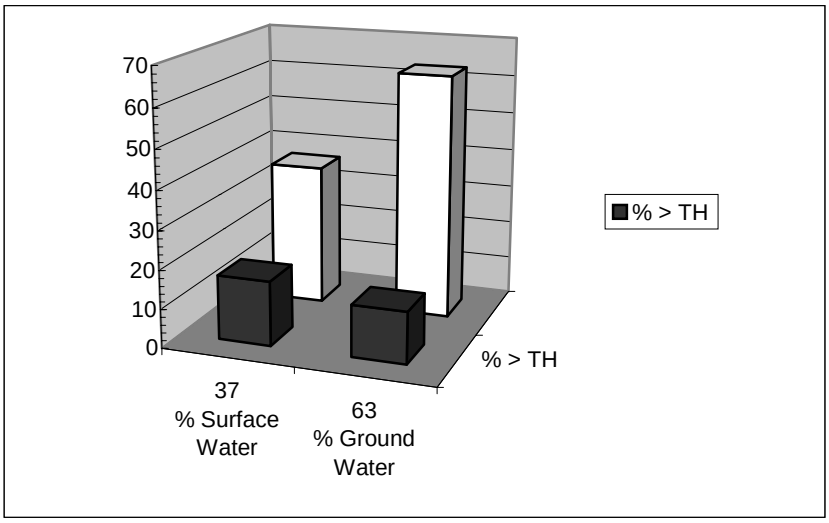

Figure 5. Dairy Upgrade Requirements To-Date

The data shown in Figure 6 is also based on very limited data. This graph indicates the number of producers applying below, at, or in excess of crop phosphorus uptake. Sixty-seven percent of the plans have been prepared to crop uptake levels or less. The remaining 33% applying over crop uptake levels are allowed to apply at elevated rates if the soil tests are below the phosphorus threshold.

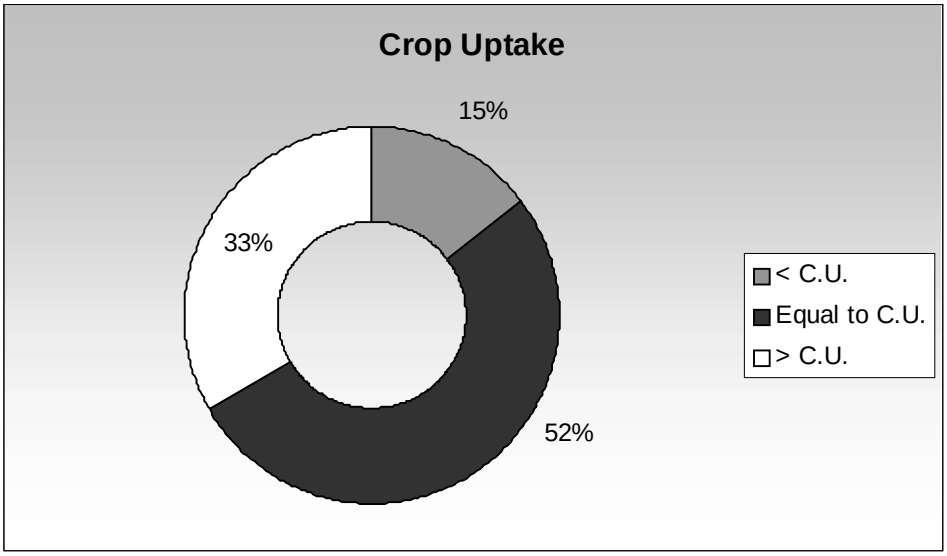

Figure 6. Dairy Upgrade Requirements To-Date

The data presented in this paper is very preliminary, as only a small portion of the facilities have been addressed with a nutrient management plan. ISDA and the other agencies involved are confident Standard will address the critical concerns related to nutrient management, including nitrogen budgeting, irrigation water management, and phosphorus application rates for animal waste applications. The regulatory soil testing will insure compliance with the plan, while reducing the requirement of manure testing and regulatory oversight of application rates and timings.

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Appendix

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT
(Acre)
CODE 590

DEFINITION

Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments.

PURPOSES

It is intended that nutrient management plans developed from this standard be used to help producers improve or maintain their level of management and expertise as it relates to the application of nutrients on the lands they own and/or control.

- To budget and supply nutrients for plant production.
- To minimize the potential for environmental damage including agricultural non-point source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.
- To properly utilize all sources of organic material including animal waste as a plant nutrient source.
- To prevent or reduce excess nutrient concentrations in the soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

General Criteria Applicable to All Purposes

- Plans for nutrient management shall comply with all applicable federal, state, and local laws and regulations.
- All nutrient management plans that address land application of animal waste shall comply with the State of Idaho Waste Management Guidelines for Confined Feeding Operations.
- Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.
- Persons who approve plans for nutrient management shall be certified through the joint Idaho Department of Agriculture, NRCS, and University of Idaho (U of I) certification program.
- A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to, animal waste and

organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

- Nutrient budgets shall use:
  1. U of I of Idaho Fertilizer Guides.
  2. Recommendations with an equivalent research database approved by a committee made-up of industry, university and agency representatives.
  3. Crop uptake values (Chapter 6, NRCS Agricultural Waste Management Field Handbook).
  4. Tables, values and guides generated from Idaho Animal Waste Management Program (IDAWM) or other state approved programs.
  5. Those contained in the NRCS Agricultural Waste Management Field Handbook, (AWMPH).
- If actual analysis data is available for applied waste, or if waste sources are unique, then use actual analysis values in lieu of standard values. If actual analysis data is not available, nutrient content of waste, organic by-products, septage, and cover crops shall be determined using standard values contained in NRCS Agricultural Waste Management Field Handbook (AWMFH) Chapter 4, ASAE D-384, or U of I of Idaho Fertilizer Guides.
- Yield goals for the crops included in the recommendation shall be based on proven yield by the producer, and achievable yield goals for the area including advancements in technology. Yield goals shall be established for every crop in the rotation.
- Nutrient management plans shall specify the form (liquid, gas or solid), source (dairy, feedlot, commercial fertilizer, etc.), amount, timing, and method of application of nutrients on each field or Conservation Treatment Unit (CTU) to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground water.
- The soil test phosphorus level above which there is no agronomic advantage for application of additional phosphorus is the Phosphorus Threshold (TH) for crops grown in Idaho. The TH is used in the nutrient budgeting process to determine application rates, and to determine trends in soil P concentrations over time. A soil test P concentration is a chemical evaluation of the capability of the soil, as represented by a soil sample, to supply plant available P during the growing season to achieve a desired yield response.
- If nutrient requirements are not available for new or specialty crops use local data from the producer or industry.
- Crop rotations shall be documented in the nutrient management plan.
- Irrigation Water Management as prescribed by the Irrigation Water Management Standard (Code 449), shall be a component of a nutrient management plan if nutrients are applied on irrigated cropland.
- Refer to the Nutrient Application Timing section of this standard for required runoff control practices.

Soil Sampling and Laboratory Analysis

- Soil samples shall be collected and prepared in a manner representative of the entire field (see U of I CES

NO. 704, Soil Sampling for an example).

- Soil test analysis will be performed using analytical methods prescribed by the North American (formerly the Western States) Laboratory Proficiency Testing Program. Soil test P will be determined using the Bray 1 method for soils with no free lime (pH<6.5) and the Olsen method ($NaHCO_3$) method for soils with free lime (pH>6.5).

Soil Testing - Development of the Initial Nutrient Management Plan

- A nutrient management plan for N budgeting shall be developed using current soil tests taken in the spring prior to seeding a spring crop, in the fall prior to seeding a fall crop, or in the spring following a fall seeded crop.
- A nutrient management plan for P budgeting can be developed using soil tests taken anytime during the year.
- Soil tests for P are taken for two main purposes: 1) to develop the P nutrient budget; and 2) for comparison to the appropriate P Threshold value. In some cases, one soil test will serve both purposes.
- Current soil tests for purposes of <u>developing the nutrient budget</u> shall be taken as described in Table 1.

Table 1	
Depth	**Nutrient Analyzed**
0 - 12 inches	NO_3 - N, NH_4 - N, P, & K
12 - 24 inches	NO_3 - N, NH_4 - N

A complete lab analysis should be made of samples taken from the first foot for all nutrient management plans.

Fields that are part of a long term sod, pasture, or alfalfa in rotation, may not require annual soil tests. Soil tests are to be taken when nutrients will be applied as part of an on-going management program.

Non-inversion cropping systems (i.e., no till) or areas where resource problems dictate closer management may require soil samples in zones less than 0 - 12".

- Soil tests taken <u>for comparison to the P threshold</u> will be taken at one of two depths, as described in Table 2, dependent upon on-site surface or ground water resource concerns.

  <u>Surface water runoff concerns</u> exist when runoff leaves the contiguous operating unit from normal storm events, rain on snow or frozen ground, or irrigation.

  <u>Ground water concerns</u> exists when a high water table, fractured bedrock, cobbles, gravel, or course-textured soils are conducive for the downward movement of water and associated nutrients.

Table 2	
Primary Resource Concern	**P Threshold Soil Sample Depth**
Surface Water Runoff	0 – 12"
Ground Water, fractured bedrock, cobbles or gravel	18 – 24"

When considering soil P levels, a surface water resource concern is the priority concern. If both concerns exist, a surface water concern takes priority. If neither concern exists, then the nutrient management plan is developed based on the TH for the ground water concern to prevent concentrations of nutrients above the agronomic requirement of the crop, and to maintain soil quality and long term sustainability of the cropland resource.

- To meet local nutrient requirements, as identified in the fertilizer guide or approved industry recommendations, the 0 – 12" soil test can be used to determine other diagnostic needs.
- Fields that are part of a nonirrigated cropland rotation that includes summer fallow do not have to be soil tested the year the field(s) are in summer fallow.
- In situations where specialty crops are raised, or environmental considerations have been identified (high water tables, leaching vulnerability, tile drains, fractured bedrock, deep or shallow soils), sampling greater than or less than the prescribed depths may be appropriate. The NRCS soil survey data is sufficient to make this determination unless site specific conditions vary substantially from the survey. The production system and environmental considerations will determine soil-sampling depth. Soil samples will represent the field or CTU being planned.
- Phosphorus Threshold (TH) concentrations by resource concern are described in Table 3. Use the primary resource concern identified and site characteristics to determine the TH of the site.

Table 3

Primary Resource Concern	P Threshold Concentration	
	Olsen	Bray 1
Surface Water Runoff	40 ppm	60 ppm
Ground Water, fractured bedrock, cobbles or gravel		
< 5 feet	20 ppm	25 ppm
> 5 feet	30 ppm	45 ppm

Soil Testing - Maintenance of the Nutrient Management Plan

- For purposes of developing annual nutrient budgets, soil samples will be taken and analyzed as described in Table 1.
- For purposes of tracking P trends, soil samples will taken and analyzed as described in Table 2 and as follows:

  Surface water resource concern: Use the soil P concentration determined from the 0-12 inch sample taken for development of nutrient budgets.

  Ground water resource concern: The TH soil test for P at the 18-24 inch zone is required to track P trends. If results of the initial soil test for P are less than 75% of the TH, then soil samples for comparison to the TH can be taken once every 5 years to monitor trends of P in the profile and to make adjustments in the plan as necessary.

Plant Tissue Testing

- Tissue sampling and testing is recommended during the growing season to monitor crop nutrient concentrations.

- Tissue sampling shall be done in accordance with U of I of Idaho guidelines or the guidelines of the laboratory performing the tissue analysis.

Nutrient Application Rates

- Acceptable nitrogen, phosphorus and potassium application rates shall be established according to the U of I of Idaho Fertilizer Guide or recommendations from an approved equivalent research database, and will be based on soil tests as identified in the previous section under Soil Testing.
- Nitrogen application rates will be determined for each crop in the rotation.
- Phosphorus application rates will be determined for a single crop or for the crop rotation. Table 4 includes P application rates based on soil test P concentrations as compared to the site TH.

Table 4

Soil Test P	P Application Rate
Surface Water	
< TH (ppm)	Recommended rates or Crop P uptake
> TH (ppm)[1]	Crop P uptake
Ground Water	
< TH (ppm)	Recommended P rate or Nitrogen based
> TH (ppm)[1]	Crop P uptake

[1] Note: When soil test P concentrations are above the TH, the planner, in cooperation with the producer, will design a nutrient management plan that will reduce soil test P concentrations below the TH and minimize potential off-site transport. This may require adjustments in crop rotation, irrigation method and scheduling, form, timing or placement of P applied, and changes in P application rates less than crop P uptake.

- If soil test P concentrations are above the TH, then crop uptake values will be used in development of the nutrient budget regardless of the nutrient source.
- Potassium application shall not exceed the recommended rate except when concentrations in the soil are determined not to cause unacceptable nutrient imbalance in crops and forage quality, and do not become limiting to crop growth and sustainability.
- Starter fertilizers are considered a part of the nutrient budget.
- Nutrient applications are recommended when plant tissue tests indicate a need for nutrient application to correct or prevent a deficiency.
- Calibrate waste and fertilizer application equipment to ensure recommended rates are applied.

Nutrient Application Timing

- Application of solid wastes. Solid waste shall be incorporated unless applications are made on frozen ground, perennial crops or cropland under no-till; in those cases, emergency tillage (i.e. chiseling and disking cross slope), construction of berms or other containment practices will be applied to prevent surface runoff.
- Application of liquid wastes. Application of liquid waste shall not be made outside the active growing period of the crop, unless a water

budget for the site shows that deep percolation of wastewater or runoff will not occur prior to the next crop-growing season. Liquid waste shall be applied to crops at amounts not exceeding soil water holding capacity in the crop-rooting zone. Application of liquid wastes through surface or sprinkler irrigation systems will be timed to prevent deep percolation or runoff. The number of applications will be based on the volume of waste to be disposed of as well as related concerns with surface runoff and deep percolation.

- Application of commercial fertilizer. Timing of applications shall be sufficient to provide adequate plant establishment, growth and residue decomposition not to exceed U of I Crop Fertilizer Guides or an approved equivalent research database or crop uptake values and to avoid surface runoff and/or leaching.
- If most of the commercial N is applied in the fall for a subsequent spring crop, applications shall be made when soil temperatures are low enough to minimize nitrification (< 50 ^{o} F), or with a nitrification inhibitor, or controlled release fertilizer.

Criteria Applicable to Utilizing Organic Waste Resources as a Plant Nutrient Source

- Organic biosolids, (i.e. waste from food processing facilities), shall be applied as prescribed by federal, state, or local regulations.

Criteria for Maintenance or Improvement of Physical, Chemical or Biological Condition of Soil

- Biosolids, other than animal waste, and sewage sludge shall be applied as prescribed by federal, state, or local regulations (40 CFR parts 403 and 503).
- Biosolids and by-products shall be applied to the soil as prescribed by federal, state and local regulations. Records of application and content of biosolids must be maintained as required by the state.

Additional Criteria to Protect Water Quality on Vulnerable Sites

- If the field or CTU lies within a hydrologic unit area that has been designated as having impaired water quality associated with nutrients, is within an area where nutrient contamination has been identified as a ground water quality concern, or is within a sole source water or wellhead protection area where nutrient contamination is of special concern due to high or very high vulnerability then, the nutrient management plan shall include an assessment of the potential risk for nitrogen and/or phosphorus to adversely impact water quality. The Nitrogen Leaching Index and/or the Phosphorus Index (PI), or other acceptable assessment tools may be used to make these assessments.
- Nutrient management plans shall include a record of site vulnerability ratings for each field or CTU and necessary conservation practices and management actions that will reduce the potential for nutrient movement from fields or CTUs with a high or very high vulnerability rating

- Utilize nutrient timing and placement to reduce Nitrogen and Phosphorus pollution of ground and surface waters. Special consideration will be given to application and placement of nutrients on sensitive areas (i.e., Highly Erodible Lands (HEL), within flood plains, near sensitive water bodies, in areas of ground water contamination from nutrient applications, within sole source water, wellhead protection areas, or within other areas of water quality concern).

  In areas of special consideration, methods will include:

  1. Apply nutrients to crop fields to avoid or reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, or wellhead area.
  2. Do not apply animal waste on sites where runoff is delivered directly to a conveyance channel or receiving water body unless runoff is treated with a conservation buffer or other mitigating practice prior to delivery.

  In areas of special consideration, recommended methods may include:

1. Split applications of Nitrogen to provide nutrients at the times of maximum crop uptake.
2. Band or place applications of phosphorus near the seed row.
3. Incorporate broadcast fertilizer on cultivated crops.
4. Farm on the contour or cross slope on all fields adjacent to wetlands if nutrient runoff appears to pose a more significant hazard than leaching.
5. Utilize fall cover crops whenever possible to immobilize residual nitrogen and retain for spring crops.
6. Utilize Conservation Cover, Residue Management, Conservation Crop Rotation, Grassed Waterway, Irrigation Water Management, Vegetative Buffer Strips and other conservation practices as needed to protect or improve water quality.

CONSIDERATIONS

- Individual conservation practices should be planned as part of a comprehensive conservation plan, which addresses all resource, concerns on the unit and reaches a Resource Management System level of treatment.
- Rotations included in a nutrient management plan should meet the criteria of the Conservation Crop Rotation standard (Code 328).
- When soil test P concentrations approach 75% of the TH, consider developing the nutrient management plan using crop P uptake for application rates. Recognize that at 75% of TH, concentrations of P are approaching the TH and management changes should be considered.
- Vary the amount of fertilizer in different parts of the field to account for differing fertilizer needs and the potential for leaching and runoff.
- Consider applying liquid wastes mixed with irrigation water during the last 1/4 to 1/3 of the irrigation set to minimize deep percolation and runoff.
- Consider split applications of nitrogen to provide nutrients at the times of maximum crop utilization, especially on fall seeded crops.

- Consider routine mineral and nitrate nitrogen status testing of forages produced from land with long term and/or heavy waste application rates. Excessive soil potassium can lead to high potassium levels in forages, especially legumes like alfalfa, produced for livestock. Excess potassium intake by cattle is associated with decreased magnesium absorption, decreased feed intake and milk production, increased intake of water, and increased urine output. High dietary levels of potassium are a major concern during the dry period. Plants with high levels of potassium and low levels of magnesium can cause grass tetany, a non-infectious metabolic disease in cattle.
- Consider limited application of organic materials with high heavy metal concentrations.
- Consider analyzing products from industrial processing used as fertilizer or soil amendments for heavy metals or other contaminants to prevent their buildup in the soil.
- Consider cover crops whenever possible to utilize and recycle residual nitrogen.
- Band applications of phosphorus near the seed row.
- Applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques.
- Delaying field application of animal wastes or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
- Consider the potential problems from odors associated with the land application of animal wastes, especially when applied near or upwind of residences.
- Consider nitrogen volatilization losses associated with the land application of animal wastes. Volatilization losses can become significant, if wastes is not immediately incorporated into the soil after application.

PLANS AND SPECIFICATIONS

- Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.
- The following components shall be included in the nutrient management plan:
  1. Aerial site photograph or map and a soil map.
  2. Current and/or planned plant production sequence or crop rotation.
  3. Results of soil, plant, water and organic sample analyses.
  4. Realistic yield goals for the crops in the rotation.
  5. Quantification of all nutrient sources.
  6. Recommended nutrient rates, timing, and method of application and incorporation.
  7. Location of designated sensitive areas or resources and the associated practices or methods planned to protect the area.
  8. Guidance for implementation, operation and maintenance of the nutrient management component of the conservation plan.

9. Complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

- When nutrient management plans are expected to increase soil phosphorus concentrations, such that concentrations approach the TH, plans shall include:

10. A caution that phosphorus accumulation in the soil can occur and that the potential for such accumulation can contribute to water quality impairment, animal health, or crop production problems.
11. A discussion of the time interval after which it may be necessary to convert to phosphorus based waste or nutrient application rates for plan implementation.
12. The potential for soil phosphorous drawdown from the production and harvesting of crops.

OPERATION AND MAINTENANCE

Nutrient Management Plan Review and Revision

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- Nutrient management plans shall be reviewed annually by the producer or their representative to determine if adjustments or modifications are needed. Annual reviewers, including the producer, need not be certified.
- The producer or their representative, shall revise the plan, as needed, to reflect significant changes in the operation that affect the overall nutrient management plan or upon change in landowner or tenant. Significant changes may include:

1. increase in livestock by 10%;
2. major changes to waste handling and storage system;
3. increase or decrease in application area by 10%;
4. change in crop or crop rotation;
5. change in irrigation system;
6. new designation as a sensitive area.

Safety

- Protect fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage. Storage of manure, fertilizers and cleaning of application equipment should be done away from a wellhead.
- Calibration of application equipment to ensure uniform distribution of material at planned rates.
- Backflow protection devices shall be installed according to Idaho chemigation requirements when using irrigation systems for application or distribution of liquid waste or commercial fertilizer.
- Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.
- The disposal of material generated from cleaning nutrient application equipment should be stored and disposed of properly. Excess material should be collected and stored, or field applied in an

appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

- The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

Field Records

- The producer will maintain field level records for a minimum of five years. As applicable, records include:

1. Soil, plant tissue, organic, and water test results as collected and recommendations for nutrient application.
2. Quantities, analyses and sources of nutrients applied.
3. Approximate dates and methods nutrients were applied.
4. Crops planted, planting and harvest dates, yields, and crop residues removed.
5. Dates of annual review and person performing the review and recommendations that resulted from the review.
6. Any additional information as required by this standard, (i.e. Site Vulnerability, Site Risk Assessment, Biosolid application records, and other appropriate cautions and discussions).
7. Suggested Additional Records as applicable:

   * Irrigation Water Management evaluations.
   * Recommended conservation practices and management actions that can reduce the potential for nutrient movement.